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AVERY'S ROTARY ENGINE.

The following letter from O. Wilder Esq., Agent of the New York and Michigan mills at Singapore, Michigan, to Mr. John M. Webster, the millwright and engineer who superintended the erection of those mills—gives a statement of much interest to those engaged in the cutting of lumber for market.

The engines used in this mill are "Avery's Rotary," built by Messrs. E. Lynds and Son, of Syracuse N. Y.; and are considered by those who have used them—*when properly put up and superintended*—to be *less* expensive in the first outlay, and *less* expensive for *fuel, repairs* and *superintendence* than the piston engine to perform the same amount of business.

Engines of this description, built by the gentlemen above named, or by Mr. Joseph Curtis, of this City, are now in *successful* operation in various parts of the United States—and especially in the Southern States, where they are superintended almost entirely by slaves, who are by most people supposed to have but little capacity for such business. One of them was exhibited at the late Fair of the American Institute in this City, in the most successful operation—driving the numerous machines exhibited there for competition.

SINGAPORE, *Michigan*, June 29th, 1839.

TO MR. JOHN WEBSTER.—SIR—On the first page I hand you an abstract of the amount of lumber sawed at the steam mill of the New York and Michigan company at this place, between the 22nd May and the 26th June by three saws—the mill during that period, has run under many unfavorable circumstances—one of which in particular, viz. bad belts have caused much delay; the material of which the belts were made is not at all suitable for the purpose. Another great cause of delay in sawing has

been the want of the hands—those accustomed to ordinary water mills find themselves quite inexperienced in this.

The mill, including the frame and machinery, having been as you are aware, erected entirely under your direction, it is with much gratification that I can now add my testimony, founded on actual experience, of the great superiority of these engines and machinery over any other kind with which I am acquainted. Yours has certainly been an arduous and laborious duty. Constructed, as these mills were, under very discouraging circumstances, you have nevertheless shown yourself to be fully competent to the undertaking, by the superior manner in which the work has been performed, as well as by the successful operation of the mills, which consist of six upright, and four circular saws, driven by two *Rotary* steam-engines, of Avery's patent built by Messrs. E. Lynds and Son of Syracuse, New York; and I am well satisfied that few, *if any* mills in the United States will compete with them in speed, convenience, or power. The slabs and offals of three saws supply the whole mill with fuel, and furnish power to each engine, to drive two circular, and three upright saws, and also to haul the logs up into the mill. And I must here express my conviction that a steam mill built after this method is, on the whole, to be preferred to any water power with which I am acquainted.

From a trial of the three remaining saws, which have only been in operation this day, I am well satisfied that they will cut as much, if not more than the three which have been some time in operation and have cut the lumber of which I herewith give you an account.

Wishing you every success and prosperity, I am very sincerely yours,

O. Wilder, *Agent of N. Y. and Mich. Com.*

Amount of lumber sawed at the steam saw mill of the New York and Michigan company at Singapore in the State of Michigan between the 22d May and 26th June 1839 inclusive by three saws:—

		Saw No. 1.	Saw No. 2.	Saw No. 3.		Saw No. 1.	Saw No. 2.	Saw No. 3.
May.	22	1783	2366	2886	10	3656	2259	4116
	23	1775	2856	2706	11	4404	3011	4056
	24	2042	3422	2982	12	5205	2860	4124
	25	1874	3250	3953	13	4880	3764	4301
	27	1695	2351	3215	14	5176	3832	4690
	28	4300	3206	2472	15	4897	3698	3292
	29	3670	3985	3231	17	3124	2522	3295
	30	3546	5466	5001	19	2765	3659	2480
	31	3226	5093	4413	20	2931	2373	2282
June.	4	3933	3869	5378	21	4482	3664	3203
	5	4170	3170	3696	22	4776	3147	4146
	6	5111	4357	4927	24	4121	4237	4434
	7	4802	2939	4144	25	4179	3573	5468
	8	5006	3445	4479	26	4026	3097	3466
		Total				105,555	95,461	106,845

RECAPITULATION.

Saw No.	1	105,555
"	2	95,461
"	3	106,845
Total		307,861

N. B.—Saws No. 4, 5 and 6 have only run one day, they are fully able to saw as much, if not more than saws No. 1, 2 and 3. O. W.

Total amount of lumber sawed in twenty-eight days sawing three hundred and seven thousand eight hundred and sixty-one feet.

Singapore, 29th June, 1839

We submit the following document to our readers, and would recommend the more frequent use of condensed and popular views of important railroad documents which, from their very nature, are not to be attempted by any one but the engineer himself. The importance of the Louisville, Charleston and Cincinnati railroad is such, that this paper of Major M'Niel cannot fail to receive attention.

ENGINEERS OFFICE L., C. AND C. R. R. CO., GREENVILLE, S. C., OCTOBER, 14, 1839.

To the President and Directors of the Company :—

GENTLEMEN :—Recurring to the extended operations of the Engineer department throughout the last three years, I am reminded, from the obvious want of knowledge of the subject, (apparent, as I think, in the nature of recent discussions at the annual meeting of stockholders at Ashville,) that, instead of expecting a general perusal of the voluminous documents reciting those operations and their results, it probably may subserve the interests of the stockholders and the public generally, if I summarily recite, as I now propose some of the more important facts which have a bearing on the enterprise committed to your management. My object will be, as far as in my power, to enable every one to form his own opinion of the real prospects of the Company—so far as may be deduced from a statement of the probable cost of constructing the railroad in its future progress to and beyond Columbia; and while I do not expect to be unerringly exact, I am willing it be recollected that on mature deliberation, I am of opinion that the following estimate will rather exhibit the *maximum* than the probable cost of the work.

It is well to premise, however, that of course the *cost* must mainly depend on the *plan* of the work; and as "entire efficiency for the important object for which the railroad is designed" will be regarded as indispensable to my plan, I shall first briefly state the few particulars, affecting *cost*, in which the several plans would differ.

1. The plan of that portion of the main trunk of the Louisville, Cincinnati and Charleston railroad, diverging from the Hamburg railroad at Branchville, and extending to Columbia, a distance of 66 miles, contemplates a road-bed of sufficient width (that of embankments being 25 feet, and of excavations 30 feet and upwards, in proportion to the depths of cuts,) for two tracks, or in other words for a double railway: the superstructure, or *railway*, to be constructed in the most approved and durable manner, with a heavy iron rail, of the form of an *inverted* T, weighing, say 56 pounds per lineal yard, and of sufficient strength to dispense with a continuous support, being merely *tied* together by transverse pieces, at intervals of three feet.

The reasons in favour of this plan were deemed to be cogent, and will be found as well in the *charter* which determined the width of road-bed for a *double track*, as in my *1st Annual Report*, pages 45 to 50, which induced the adoption of the rail described.

2. The foregoing plan may be advantageously modified in the progress of the road above Columbia, to a width sufficient for but one track, with requisite passing places, (the embankments being not less than 16 feet width and the excavations in order to provide drainage, not less than 22 feet,) retaining the same description of railway, with the permanent iron rail.

The first question is, will this plan be efficient? I think it will—for, generally speaking, two tracks are not indispensable to the *accommodation of trade* (and in this case I am sure will not be,) but rather for the *securi-*

ty of trains passing in opposite directions on serpentine roads, where the vision being frequently obstructed, two tracks are desireable—whereas our road is remarkable for its extent of straight lines, and the absence of abrupt curvatures. When necessary, the road-bed, moreover, can be widened, and meanwhile its reduced width would result in a saving of about one-fourth the first outlay estimated for a double road-bed.

3. It admits of a still further modification, reducing as before, the width of road-bed, and substituting a light iron rail, or bar, (similar to that used on the railroads in Georgia, and in most other States except Massachusetts,) requiring a continuous support on wood, as practised on the Hamburg and other similar roads.

This plan is objectionable because of the perishable nature of the railway, and the consequent annual outlay for repairs; nevertheless, such a railway as is contemplated may be constructed at an average not exceeding $5000 per mile (its cost varying with locality,) at least equal in efficiency to any of our southern railroads, and resulting thereby in a saving in first cost of about $5000 per mile less than by the second plan described, which, as above stated, would also reduce the first cost by either the second or third plan, one-fourth the total cost of graduation on the plan originally proposed and adopted.

Having made these explanations, I proceed to a statement of the probable cost of the railroad, on the foregoing plans, from Branchville to Knoxville.

1. As per plan No. 1:—

Branchville to Columbia, distance 66 miles, cost,	$1,600,000
Thence by probable route to the North Carolina line, 114 miles,	2,750,000
Thence to Butt Mountain Gap (summit of the Alleghany) 23 miles	1,250,000
Thence to the boundary line between North Carolina and Tennessee, 74 miles,	1,600,000
Thence to Knoxville, 70 miles,	1,400,000
Total cost by first plan, with a double road-bed, and a permanent iron rail,	$8,600,000

Extending through South Carolina 180 miles, and costing	4,350,000
Extending through North Carolina 97 miles and costing	2,850,000
Extending through Tennessee 70 miles, and costing	1,400,000
Total as above,	$8,600,000

Before I proceed to state the probable cost by either of the other plans, it is well to remind you that (in consequence of the progress already made between Branchville and Columbia) no material diminution can be made in the cost of the *road-bed* between those points; and that as the heavy iron inverted T rail has already been ordered, and is daily expected, sufficient for about twenty miles of the road, a reduction even in the cost of the *railway* to Columbia, could only obtain for the remaining 46 miles—on which suppositions I proceed.

2. As per plan No 2, with a single road-bed, (above Columbia,) and a permanent iron railway.

From Branchville to Columbia, double road-bed,	$1,600,000
Thence to the North Carolina line, single,	2,350,000
Thence to Butt Mountain Gap, single,	1,000,000
Thence to the Tennessee line, single,	1,385,000
Thence to the city of Knoxville, single,	1,225,000
Total cost by the above plan,	**$7,560,000**

The coast of that portion in South Carolina being	$3,950,000
The cost of that portion in North Carolina being	2,386,000
The cost of that portion in Tennessee being	1,225,000
The whole cost being	$7,560,000

3. As per plan No. 3, substituting a lighter iron rail requiring a continuous support, or for a railway similar and equal to those in Georgia and other southern States.

From Branchville to Columbia,	$1,400,000
Thence to the North Carolina line,	1,780,000
Thence to the Butt Mountain Gap,	885,000
Thence to the Tennessee line,	1,015,000
Thence to the city of Knoxville,	975,000
Total cost by the 3d plan,	$6,055,000
The cost of that portion in South Carolina being	3,180,000
The cost of that portion in North Carolina being	1,900,000
The cost of that portion in Tennessee being	975,000

The average cost per mile would be, then, by plan No. 1, with a double road-bed and permanent rail,	$24,784
By plan No. 2, single road-bed above Columbia, and permanent rail,	21,787
By plan No 3, single road-bed and flat rail,	17,450

or the average cost per mile, if even built on the most expensive plan, (as regards first outlay,) will but little exceed what was stated at the annual meeting to have been the average cost of railroads in the United States, (to wit, $20,000 per mile;) while from my own personal knowledge I do know that similarly constructed works, the railroads which radiate from Boston and perforate the Bay State in almost its remotest corners, cost on an average upwards of $40,000 per mile (some of them nearly $60,000,) which is in proof of what was so much dwelt on at Ashville, that "*in the south we have advantages in formation of country, growth of materials, etc., by which we should be enabled to build roads cheaper than at the north.*"—The offset to this is, that whenever mechanical skill is to be brought in requisition, they having more of it, because of more constant demand for it, can more easily command it, and at a cheaper rate. Nevertheless, under all the circumstances if the means be afforded it seems that we may even traverse the Alleghany mountains *through the Carolinas* connect together the south with the west, make as it were a central navigable stream through South Carolina, afford an outlet from Western North Carolina, *redeem the faith* of the projectors of our great enterprise, at less than it was deemed proper to expend—calculating, as they (the Yankees) did, the cost—to promote the mere convenience of the travelling public, and that communion resulting simply from intercourse among themselves. True, they have reaped a golden harvest pecuniarily. I do not mean to say that we shall; and by no means that we shall not. But they by no means expected so adequate a return on their invested capital. Trade and travel have far surpassed (as in all similar cases they have) their most sanguine expectations. And why should there, in our enterprise prove an exception? On this subject I will merely add that those most expensive railroads (so far as first cost may characterise them as such) have yielded, from their first "opening" to the public, from 6 to 9 per cent., and some of them 10 per cent. And recuring once more to assertions in the convention at Ashville, it shows how

fallacious would be the argument (if such it could be termed) that "*inasmuch as—according to Chev. de Gerstner—the average cost of railroads has been* $20,000 *per mile, and the average income* 5 *per cent;* THEREFORE, *wherever the cost exceeds the average, the income must be proportionably diminished!*" As well might it be inferred, that because our most expensive railroads (in first cost) yield more than the average—nearly the double of it—*therefore*, the more expensive their construction the more profitable ultimately!

The truth is this—railroads have proved profitable from a cause indespensable to the profitableness of all similar works, to wit:—Their (in the extended sense of the word,) economical management, under the administration of but a very limited number of agents, adequately recompensed, with full authority, under the board of directors, held to a strict accountability, and *judged by their works.* It is not a bad criterion, in such a case to compare the outlay with the income, the difference being the nett reveue; and I hazard the opinion that the latter is more generally the result of a judicious construction of the road, (avoiding as far as means will permit, the necessity of constant renewals and repairs, which consume the income,) and an economical subsequent management of the work, than of the greater or less amount of trade; for, without adducing instances, it is a well known fact, that cases have occurred where, large as the income has been, and gradually and rapidly increasing, that the expenditures have increased in a greater ratio, and absorbed even more than the whole receipts.

Returning to the estimates of cost, I respectfully submit, if it be not rather expedient that a reduction in cost be effected by a diminished width of road-bed (*retaining the utmost efficiency of the whole work*) than by the substitution of a lighter and more perishable railway; and in this view of the case I recommend to your adoption plan No. 2, rather than plan No. 3, by which the cost within the several States will appear, as herein before stated, materially less than heretofore expected.

And as there seemed to have been at Ashville some misapprehension of the estimates on which were based contracts for the work in progress toward Columbia, so far obscuring, I think, the subject that possibly some may still be under the impression that the estimates were extravagant, and the contracts entered into by the board equally so—it may be well to state that pains were taken to give all the elements on which the estimates were based—(that in so doing, we "might perchance disseminate, as was desirable, useful information to those interested in the subject, and especially to such as should in the further prosecution of the work compete for contracts;") that those estimates have stood the ordeal of critical analysis of competent engineers, (practically conversant with their profession;) and what is most material, experience, in the progress of the work, has fully satisfied me that they are not as liberal as they should have been and were intended to be; for I much fear the contractors will scarcely in any case be more than indemnified for their actual expenses, to say nothing of what they are justly entitled to—some compensation at least, beyond their expenses.

The contract prices on the Hamburg railroad having been cited, (I suppose as a just criterion,) I will merely state that it is demonstrable that *yard for yard*, and in every way that they can be compared, (for the two structures are as dissimilar as a ship and a house) it has cost more than the Louisville, Cincinnati and Charleston railroad so far. The latter, at any rate, does not exceed the cost of the former, $1000 per mile, graded as it is for a double track, (the former being graded to a width of but 13 feet for a single track, and generally nearly coincident with the natural surface) while the

Louisville, Cincinnati and Charleston railroad, moreover, in its direction from Orangeburgh to and across the Congaree river, lies transverse to the intervening ridges and valleys; including too, an expensive viaduct and much *masonry*—of the latter of which there is none on the Hamburg railroad. It is to be assumed, therefore, that so far as the cost of construction of the Louisville, Cincinnati and Charleston railroad thus far may be judged by comparison with that of the Hamburg railroad, (and I add with that of any other railroad ever built) it will not be disparaged on the score of cheapness and economy and ultimate efficiency. Referring to the last annual report for information on the progress and condition of that portion of it now under contract, I will merely repeat that it is very practicable to complete and put in profitable use the whole of it to Columbia within the next ensuing year—and, as stated in my first annual report, "if vigorous operations be persevered in, I am sanguine in the belief they will enable us to triumph over every obstacle, and as early as the year 1846, to celebrate the entire completion of this stupendous enterprise"—connecting the southern Atlantic sea board with the west, without reference to a Lexington, a Louisville, or any other *place*, but rather to whichever may be its most eligible point on the Ohio or the Mississippi river.

It remains for me to add a few words on the much talked of expenditures of the engineer department. Unquestionably they have been very large; but by no means disproportionate to our greatly extended operations, beyond any similar which have elsewhere been attempted in the same limited period of time. For instance, in the short space of the first six months prior to the 1st annual meeting, two years since, investigations by recognizance and experimental surveys, were required to determine not only the practicability of the whole project, but the relative merits of various routes, which in their total modifications amounted in the aggregate to quite minute surveys for about 2000 miles in extent! This of course required a large force and an outlay for instruments (when the demand for them generally was very great, and their price proportionably great) beyond our future wants. A rigid investigation however, by a committee of the stockholders, attested the industry of the several brigades, and the economy with which the affairs of the department have been administered up to that time; and similar testimony is on record from committees of directors, who from time to time have in the usual vigilance of the board, been appointed with a similar design. In fact I am bound to state, that in no instance has there been any one employed whose services could advantageously have been dispensed with; that the greatest amount of duty compatible with its due discharge, has uniformly been assigned to each; that a compensation pecuniarily, none has received equivalent to the value of services rendered; and lastly, that each and all who have been employed in the service have done their duty, to the entire satisfaction of the chief engineer, (and I think I am fully authorized to add, to that of our late lamented president and of the board of directors,) and that they may well be as they are, content to be judged *by their works*, rather than any other testimonial of merit.

Appreciated, however, as all now in the service of the company are, personally and professionally, and reluctant as I am to dissolve with either, even temporarily, a connection such as has existed—a re-organization of the engineer department, "on a scale proportionate to reduced operations," must, for a time at least, recommend the services of some to be dispensed with. A great source of unavoidable expense heretofore (*extravagance*, possibly some have thought it, although I confess I do not think unavoidable expenditure necessarily implies extravagance,) will have already terminated in the completion of the surveys to such extent that the engineer

department may be so reduced and re-organized, retaining its efficiency, that the cost probably will not much, if any, exceed the sum of $16,000 per annum. For my own part I cheerfully propose the voluntary relinquishment of my own salary hereafter, to whatever extent may be desirable. My services I feel it due to the work and to myself, therefore, yet awhile to continue to render. In fine, gentlemen, in whatever I can to the extent of my ability—I trust I shall not be found wanting in the most cordial co-operation with you in the discharge of your arduous (I was about to say most *onerous*) duties; limiting our expenditures to the *minimum* consistent with a wise economy and enforcing the most economical administration in such affairs as may, under your instructions, depend on me.

I have said that my personal services, I am aware, cannot at once be dispensed with; it is the result of the late recent melancholy occurrence in the death of our President, which has, for a time, devolved unexpected duties on me, requiring *continuous* service on my part: else I should have at once proposed, what I hope soon may be accomplished, that my future relation to the work should rather be that of a consulting engineer, (visiting the road periodically, or as exigencies might require) than as I am and have beenfor the most part confined to it. Impelled as I was when I first yielded toyour flattering, because unanimousand unsolicited invitation, to acceptthe distinguished post I have the honor to occupy, to wit, becauseofyour impression that I could be useful to your great enterprise, and my hope that I might fulfil your expectation, together with an earnest desire on my part to further, as far as in me lay, the more particular interests of my native section of country—so shall I most cheerfully return to you the responsible trust confided to me, whenever a suitable occasion shall present to enable me consistently to do so.

Repectfully submitted by

Wm. Gibbes M'Neil.

Chief Engineer, L. C., & C. R. R.

TO JOHN DOVOR AND WILLIAM JONES OF LONDON, FOR THEIR INVENTION OF IMPROVEMETS IN FILTERING FLUIDS.

This invention relates to a mode of clarifying such fluids as require such a process so as to render them fit for use, and consists in causing such fluids to pass through the skins of animals by the aid of pressure, by which means a high degree of purification takes place.

The skins employed for this purpose are sheep skins, in preference to others, although the skins of other animals will answer the purpose. These skins should not be tanned, but are to have the wool cut off, and are to be treated in the same manner as if they were going to be tanned, as will be readily understood by tanners. The skins, when prepared, must be laid on some supporting surface, such as hair cloth, when placed in the filter, as the strain or pressure to which they would be subjected would otherwise quickly injure the texture of the skins.

The Patentee says, in conclusion, that the fluids to be clarified or filtered may be forced upwards through the skins, if thought preferable: and they claim as their invention, "the application of the skins of animals as a filtering medium to filtering apparatus or machines for clarifying or purifying such fluids as require that process."

Launch of the East India Companie's Armed Steamer Sesostris.—The launch of this beautiful vessel took place on Tuesday from the dock-yard of Mr. Pitcher, at Northfleet. The Sesostris is one of a class built by order of the East India company, for the express purpose of

protecting their trade in the Indian seas. She is a magnificent vessel, of the highest order of naval architecture, and is altogether worthy of the important post, assigned to her.—*English paper.*

RAILWAY SOCIETY.

We find in the Civil Engineer and Architects' Journal, for April, a notice of a meeting of delegates from the principal Railway Companies in Great Britain, " for the purpose of considering the propriety of forming a Society for promoting, and advancing the scientific improvement of railways, throughout the kingdom; and for protecting generally the interests of railroad proprietors." The idea is a good one—and we recommend the subject to the same class in this country, as there can now, we are fully persuaded be little danger in asserting the opinion that railroads are to become the *leading* medium of *transportation* as well as of travel—and will of course involve the interests of more people than any other branch of business except agriculture.

A private meeting, very numerously attended by the deputations from most of the leading railway companies, was held on Saturday last, at the chambers of Messrs. Burke and Venables, in Parliament St., for the purpose of considering the propriety of forming a society for promoting and advancing the scientific improvement of railways throughout the kingdom, and for protecting generally the interests of railway proprietors.

Mr. George Carr Glyn, the chairman of the London and Brighton and North Midland railway companies, was called to the chair, and opened the proceedings by adverting to the great and manifest importance of the proposed society, as affording a means of bringing the united experience and influence of the principal persons connected with railways to bear upon all questions which may arise respecting them.

The honorable chairman further alluded to the very great ignorance which exists among many, even at this day, on the subject of railways, and the consequent prejudices which prevail against them, and pointed out the great advisability of having some regularly organized association which would be looked up to as an authority on all subjects in which their interests were involved.

The meeting was subsequently addressed by several other gentlemen present, who all concurred in the importance of the proposed association, and dwelt on the advisability of forming, at its outset, a collection of maps, reports, models, and other scientific and statistical details relating to railways, which should be accessible to the several members of the society, and which would in time become a most valuable and interesting museum of reference on matters connected with railways.

Some discussion took place as to the amount of the subscriptions, and the name to be given to the proposed association, viz: whether it should be called the "Railway Society," or the "Railway Institute;" but eventually this, with all other matters of detail, was left to a committee of management formed of some of the directors of the principal railway companies present, who were empowered to add to their number, if they should see fit.

Resolutions, embodying the substance of the foregoing remarks, were unanimously passed, and the several persons present, having enrolled their names as the first members of the society, the meeting separated.

BLASTING BY THE AID OF GALVANISM.—INTERESTING EXPERIMENTS ON BLASTING AT CRAIGLEITH QUARRY.

On Tuesday, 26th of March last, a large party of gentlemen assembled in Craigleith Quarry, to witness some experiments on blasting by means of galvanism, which were made at the request of the directors of the Highland and Agricultural Society of Scotland by Martyn Roberts, Esq.

It has long been known that the ignition of gunpowder can be very effectually produced by the application of the electric fluid; but Mr. Roberts has succeeded in producing an apparatus for this purpose, which is simple in its structure, very portable, and which, above all, is easily managed.—He has also, in the application of this apparatus to blasting rocks, introduced various modifications of its arrangements, and effected great improvements in the mode of charging.

The apparatus consists of a small trough, about a foot in length, and four inches square on the end, and a battery containing ten pairs of plates.—Along the battery runs a bar upon which a tin disc slides freely. This disc, when drawn to the end of the bar, touches another disc, and thus completes the connexion between the opposite poles of the battery. To prevent accidents, the sliding disc is kept in the middle of the bar by means of a spring of coiled wire; and it is impossible to put the battery in action although sunk in the trough without shifting the plate along the bar to the opposite end of the trough. The copper wires which convey the electric fluid to the gunpowder are kept separate during their whole course by a sheath of cotton thread, which is wrapped closely round them in the same manner as in the strings of a guitar, or as in the wire which stiffens the rim of a lady's bonnet. At their termination these wires are bent outwards and their extremities are connected by means of a fine steel wire half an inch long, so as to form a small triangle, like the Greek capital *delta.* This triangular end is inserted into a small tin cartridge, and ignition of the powder contained in the cartridge is produced by the deflagration of the steel wire which connects the ends of the two copper wires. So rapid is the progress of the electric fluid, that it is impossible to measure the interval of time which elapses between the action at the trough and the explosion of the cartridge. The cost of this apparatus is only about fifteen shillings; and the price of the materials required for the solution is such, that a shilling will cover the expense of keeping the trough in a working state for months. The copper wire which, if properly shielded, may last for years, costs about one farthing for each yard. In applying this apparatus to blasting, Mr. Roberts makes the following arrangements:—In regard to the mode of charging, which is perhaps the most important peculiarity of his method, he leaves a space of about one foot, containing atmospheric air, above and below the gunpowder; and thus obtains, over and above the effect of the gunpowder, all the power which the sudden increase of its volume produces; and thus the same effect is obtained from a smaller charge. He also inserts the tin cartridge into the heart of the charge of powder, and as the cartridge explodes at both ends, the gunpowder is much more instantaneously ignited. Lastly, in tamping, no vent-hole is left, as in the common system, by the withdrawing of the needle; but the tamping is pressed closely round the wire which conveys the electric fluid from the trough to the cartridge. When the tamping is completed, the battery is plunged into the trough which is at the distance of 40 feet from the bore-hole and may of course be removed as far as may seem desirable, by giving a small increase to the power of the battery if required, which is easily effected by adding a pair of plates. The spring of coiled wire still keep-

ing the tin disc in the middle of the bar, there is no risk of an unexpected explosion, a danger which occasionally happens by the too rapid ignition of a train or fuze in the common method of blasting. Every one having retired, a person stationed at any safe distance, pulls a string, which makes the tin disc pass along the bar, and the instant the connection of the opposite poles of the battery is established, the explosion takes place. We shall briefly detail the chief advantage of this new system of blasting, which we conceive to be as follows:—

1. Freedom from the dangers which always attend blasting is obtained from various causes. In the common system, the fuze or train must be fixed at or very near the bore-hole, long trains being expensive and uncertain in their action; and accidents, from the too rapid burning of the fuze, are unfortunately very common. But in Mr. Roberts' system, the person who pulls the string which puts the battery in action, may be stationed at any convenient distance. In the present system, perhaps the most common source of accident is the withdrawing of the needle; and this is completely avoided in Mr. Roberts' plan. Lastly, there is less chance of failure, and when failure does occur, the bore-hole may be at once approached without risk of accident, as the moment the string is slackened, the action of the battery ceases.

2. The next advantage is, the great facility which this mode gives for blasting under water. This is one of the most inconvenient, expensive, and uncertain of all engineering operations. It involves much trouble and expense in laying hoses for the train or fuze, which are destroyed every time; and after all, there are, perhaps, three failures out of ten trials. All this is avoided by Mr. Roberts' system, which is as efficient under water as above it, and involves not one farthing of loss under water more than on land.

3. The great advantage of a much more rapid ignition of the gunpowder, which encloses the cartridge on all sides, and receives the action of the flame over the greater part of its surface at the same instant, gives the new system a great superiority. This is a most important element in the effect of the charge, as its full force is thus secured. In the present method, on the other hand, the powder is fired from the top, and when hard rammed frequently burns away in a series of smaller explosions, producing successive shocks, separated, it is true, by imperceptible intervals of time, but yet producing an effect greatly less powerful than they could have done if concentrated in one shock, so as to act simultaneously.

4. There is absolutely no vent-hole in the mode of tamping pursued by Mr. Roberts, which mode cannot be applied to the present system of blasting. This is an important gain, the vent-hole being a decided loss of power, which is well known to gunners, and to counteract which, the Turks are in the habit of covering the touch-hole of their guns with a bag of sand the moment the priming is fired.

5. The advantage of enclosing a column of atmospheric air, as practised by Mr. Roberts, is obvious, for the force exerted during its expansion is added to that of the gunpowder itself. What that expansion may be it is difficult to tell, as we have no good means of ascertaining the increase of temperature which accompanies the explosion of gunpowder: but as the volume of atmospheric air is doubled for every increase of temperature of 450 degrees of Fahrenheit, the force produced by the expansion of the enclosed column of atmospheric air must form an important addition to the effect of the gunpowder.

6. It follows necessarily from what has been said above, that the combined effects of the instantaneous ignition of the gunpowder, the absence of

all vent-holes, and the expansion of the enclosed column of atmospheric air must cause a much greater effect than the explosion of the powder alone in the common system can produce, and consequently that a great economy in the article of gunpowder must result. This is a far more important item in the expense of quarrying and rock excavation than is generally imagined by those who are unacquainted with such works. In the excavation for the Philadelphia water works, for example, nearly 3000*l.* were expended in gunpowder, and at the rock-cutting for the new approach to Edinburgh, by the Calton hill, 1000*l.* were spent in this item alone. In granite quarries the powder for a single shot often costs 3*l.* If the method of Mr. Roberts produces a saving of about two-thirds of the quantity of gunpowder required for blasting, as would appear from the experiments which were made on Tuesday, some idea may be formed of the great economy which would follow on the adoption of the new system.

7. The system of Mr. Roberts makes the simultaneous firing of several blasts easily practised; and in many situations where the removal of the men to a place of safety is difficult, this is an important advantage.

The following details of the experiments made on Tues day, by Mr. Roberts, are chiefly taken from the notes made by Mr. Inverarity, of the Madras engineers.

No. 1. Bore of hole, 2½ inches; depth, 3 feet; powder used, 2 pounds; column of air left in the bore, only 3 inches in height; line of least resistance, 18 inches: the effect was good; the rock was much splintered, and some fragments were thrown into the air.

No. 2. Bore of hole, 2¾ inches; depth of hole, 8 feet; half the usual charge of powder used; column of air left, 2 feet in height; effect enormous;—immense mass moved; few fragments thrown into the air; deep rents all round, and large masses loosened.

No. 3. Bore of hole, 2¾ inches; depth, 6 feet; two-thirds of the usual charge of powder; column of air left, 18 inches in height; few fragments thrown into the air, but large masses loosened.

No. 4. Dimensions of hole same as the last; charge of powder, less than one-half the usual quantity; column of air left, 2 feet in height; effect very good indeed; much rock loosened; no fragments thrown into the air.

No. 5. Bore of hole, 2¾ inches; charge of powder, two-thirds of the common charge; column of air left, two feet in height; effect excellent; about 300 tons of rock supposed to be torn away; much rock loosened, and deep rents observable: no fragments thrown up.

Nos. 6 and 7. No account of bore-hole taken; powder, one quarter of the usual charge; effect of both was good.

No. 8. Experiment under water. In this experiment, five pounds of powder were put into a bladder and sunk to the depth of ten feet under the surface of the water, in a deserted quarry west of Craigleith. The string was drawn, and the effect was instantaneous; a dull red globe of light, caused by the explosion of the powder under water, was observed, and immediately there followed a considerable shock which was sinsibly felt on the margin of the pool, at the distance of about 100 yards from the explosion; a mass of water about 10 feet in diameter, and 2 feet in height shaped like a flat dome, rose above the surface of the pool, and immediately after it disappeared, the mud and burned powder boiled up from below like a cauldron.

The directors of the Highland Society in attendance, and all present were highly pleased with the complete success of the experiments.—*Edenburgh Advertiser.*

Railway Signals.—The annexed statement from Roscoe's work on the London and Birmingham railway, describes a system of signals, to prevent accidents on railroads—and we recommend it to the directors of railroads in this country, and urge upon them the adoption of this or *some other plan* to prevent the occurrence of accidents, which are becoming quite too common—and are often used against the "railroad system." We do not however admit for a moment that in proportion to the number of passengers, and business, and experience in their use, a greater number of accidents occur on railroads, than by other modes—yet as accidents *do often occur*, it is the imperative duty of the directors of railroads to adopt a thorough system of police to prevent them.

Every station of the Birmingham railway is furnished with an alarum, to give notice of the approach of each train, and to summon the whole of the men to their appointed places. These alarums are so constructed, that a weight is wound up after they have performed their office which prepares them to perform it again. On seeing the forthcoming train has reached the proper spot, the policeman stationed at them pulls a trigger, and the weight begins to descend, ringing a loud gong-shaped bell by means of internal machinery. Bells are also hung so as, in a few seconds, to collect together the whole of the men belonging to the station for any required purpose.

The police are placed along the line at distances varying from one to three miles, according as local circumstances rendered it necessary. Each man has his beat and duties defined, and is provided with two singal flags, one of which is red and the other white; the white flag is held out when no obstruction exists: and, on the contrary, the red flag indicates that there is danger, and that the train must not pass the signal till it is ascertained that the cause of danger is removed.

Each policeman, also, is furnished with a revolving signal lamp, to be used after dark: which shows, at the will of the holder, a white light when the line is clear; a green one when it is necessary to use caution, and the speed of the train be diminished; and a red light, to intimate the necessity of immediately stopping.

The following statement in relation to the first years performance of the Steam Ship "Great Western" must be highly satisfactory to the early friends of Atlantic steam navigation.

Great Western Steam Ship.—A half yearly general meeting of the proprietors was held in Prince's St., Bristol, last week. Mr. Maze took the chair. Mr. Claxton read the report, which stated that the company's first ship had disproved all unfavorable auguries, and promptly rewarded the enterprise of the projectors. It was impossible to speak too highly of the qualities of the Great Western steam ship; after having run 35,000 nautical miles, and encountered 36 days of heavy gales, her seams required no caulking, and when she was docked she did not show a wrinkle in her copper. The average of her passages out was 15½ days, and home 13 days; the shortest passage out was 14¼ days, and the shortest home 12¼. About 1000 passengers had gone in the ship. After alluding to the great expense necessary to combine speed, security and enjoyment, it expressed a hope that through the liberality of the American Congress the duty of 2d. per bushel on coals would be given up, and thus a saving of

nearly 1,000*l.* a year would be effected. The company have decided on constructing their next vessel of iron, for which the preparations are far advanced. It appeared from the statement of accounts, that after paying 2,000*l.* for additions to the ship, and insurance to October next, 1,500*l.* for goods damaged in the hurricanes in October last, and upwards of 2,000*l.* being set apart for a reserve fund, there remained from the profits sufficient for a dividend of 5 per cent., making, with the former one of 4 per cent., 9 per cent. for the year The report was unanimously adopted.

WESTMINSTER BRIDGE.

We before noticed a commencement of the works for the repair of Westminster bridge, in a former number; a dam has since been completed round two of the piers on the Westminster side, and a beginning made with the piling round them.

The great extent of the coffer dam (being no less than 500 feet in circumference,) as also the difficulty experienced in driving the piles through a hard crust of gravel which overlays the clay at this place, and the care that must have been taken in doing the work, by so effectually shutting out the water, makes it appear to us truly astonishing that so much has been done in the short period of eight months, especially as all works of this nature depend so very much upon the weather and tides.

Great credit is due to the parties in charge of the work; and, if we may judge from the earnest manner in which they are proceeding, the public will have no cause again to complain of the tardy progress which hitherto marked every thing connected with this bridge.

Neither can we omit to state, that upon our late visit, the gratification we experienced in witnessing the very dry state of the work, and although the level at which they are now proceeding is several feet below the bed of the river, there was not the slightest leakage; and we understand that the same has been the case since the completion of the dam.

The plan of operation for protecting the foundation of the piers, from being undermined by the wash of the river, is, by surrounding the caisson upon which the pier is built with sheet piling, driven as close as it is possible to bring wood and wood together. The piles are driven fourteen feet into the solid ground below the bottom of the stone work; they are 12 inches thick, and the space between the pier and the piles is afterwards filled in solid with concrete, upon which masonry of square stones of large dimensions is laid, the top of the piles being dressed off to a fair and uniform line, and further secured with a strong band or wailing of timber, encircling the whole tie, which is held in its place by iron caisson bars, firmly fixed to the main timbers of the caisson.

By this plan very little obstruction will be offered to the current, should any further increase of depth in the river take place, and from what we saw of the care taken to make the joints close, there will not be, in our opinion, the slightest apprehension for the safety of the bridge, should the river deepen three times as much as it has since the removal of London bridge—a circumstance very unlikely to happen.

In comparing this method of work with endeavoring to accomplish the same object by diving bells (which was the plan, till lately, followed at this bridge,) there cannot be a question which is the best; in one, all is done in the dark, or otherwise hid from view; while in the other it is seen as the work progresses; in truth, the last is the only proper course.—*Civil Eng. and Architects' Journal.*

Baltimore and Ohio Railroad.—It is gratifying to learn that this great *pioneer* work is to be continued. By the annexed paragraph from the Baltimore Patriot, we learn that the president of the company, the Hon. Louis M'Lane, has been successful in negotiating Maryland State Stock, to an amount which will enable the company to continue, their operations, even in these difficult times—and of course until they reach the Ohio river an ultimate result, which we have never for a moment doubted—however much we have regreted its delay.

"Among the passengers in the Great Western is the Hon. Louis M'Lane, president of the Baltimore and Ohio railroad company, who visited England for the purpose of disposing of the Maryland State bonds given to that company in payment of its stock subscription of $3,000,000. We are gratified to learn that he has succeeded in making such an arrangement in London as, under the peculiar circumstances of the money market there, is considered quite satisfactory, and the effect of which will be to enable the company to continue the prosecution of its work westward with vigor.

Iron Ship.—The largest iron sailing ship in the world is now building in Messrs. J. Ronald and Co.'s yard, Footdee, Aberdeen. This stupendous vessel is of the following dimensions:—Length of keel, 130 feet; breadth of frame, 30 feet; depth of hold, 20 feet; length over all, 137 feet; tons register, 537. Judging from her appearance, she is a beautiful model, and will carry an immense cargo on a small draught of water. She is intended for a company in Liverpool.—*Aberdeen Herald.*

"PROGRESS OF RAILWAYS" IN EUROPE.

Under this head we find in the "Civil Engineer and Architects' Journal" for July last, the following statements in relation to the progress of Railways in England; many others of much interest might be added, but these are sufficient to show that the progress of the system is *onward;* and it is also gratifying to learn that these numerous important works, so creditable to the companies by which they are constructed, are most, if not all of them, yielding a liberal return to the share holders upon their investment.

The Liverpool and Manchester Road, it will be seen by an extract from their last report annexed, continues to pay a *semi-annual* dividend of $4\frac{1}{2}$ per cent. upon its immense cost.

Opening of the Eastern Counties Railway.—This railway was opened on Tuesday, the 18th ultimo. A large concourse of persons assembled at the temporary station, Devonshire street, Mile-end, to witness the departure of the first train on this line of railroad. The line commences at Shoreditch, on a viaduct about twenty-one feet above the level of the ground, up to which extensive and commodious carriage approaches will be made. At the commencement of the viaduct it is proposed to erect the London station, which will be of commensurate extent with the existing traffic. In it are several bridges, the arches of which are faced with stone, which gives them a handsome and imposing character, especially the bridge over Devonshire street, the arch of which rises less, for the span, than we have observed on any other line of railway, the rise being less than one-tenth of

the span. The whole of the arching has been effectually protected from the effects of damp by a thick coating of asphaltum. The line then passes over the Regent's Canal by an iron bridge, the general appearance of which has been much admired; two main ribs of iron of fifty-four feet span, partly on the bow suspension principle, are thrown over the canal, to which transverse girders are fixed, supporting the roadway, on which are laid longitudinal sleepers of timber receiving the rails, an ornamental railing gives a finish to the whole. Passing successively over the river Lea, Grove Road, Coborn Road, Fairfield place, and Old Ford Lane Bridges, besides numerous other smaller archways, the railway passes over the Stratford marshes within a few feet of one of the extensive reservoirs of the East London Waterworks, crossing the river Lea by an arch of 70 feet span, rising one-fourth only; the arch is turned in 10 half brick rings; the appearance of this bridge (as we expressed in our review of Cresy's work on bridges in which drawings of it appear), is at once light and elegant, although sufficiently massive to prevent any idea of weakness. The embankment beyond the river Lea is 25 feet in height, in the formation of which considerable difficulty occurred owing to the very unstable nature of the ground on which it was raised, it being, in fact, a mass of spongy vegetable matter to a very considerable depth. Much assistance was derived in the execution of this part of the work by the formation of a staging on rough piles in advance of the embankment, and on which the wagons were run and tipped with great rapidity; of course by this means the earth was deposited over the subsoil to any required height, and the tendency of the ground "to spew up" prevented. On this part of the line there are numerous bridges over the various streams and rivers which the railway intersects, some of which are of considerable magnitude, such as the Stratford viaduct of five arches, each thirty-six feet span, Kent's Mill Bridge, of four arches, and the Abbey River Bridge, all of which are over tidal currents, besides numerous other small archways. The Stratford station is erected after the style of a plain Italian villa, fitted up with waiting-rooms, carriage shedding, engine-house, and repairing workshops for the engines. The depth of the cutting which immediately follows this station varies from ten to twenty feet. The Ilford station, which is only now being erected, is obviously incomplete. The tunnel or bridge at the crossing of the great Essex road evinces great judgment, it is 130 feet long, with iron girders resting on the abutment walls, from flanges on their lower parts small arches in cement are turned, carrying the turnpike road above; a little beyond this are some well executed culverts formed with iron pipes 3 feet diameter. The portion of the railway now open to the public, terminates at Barrack Lane, immediately adjacent to the town of Romford; the total distance is about ten miles and a-half, which the trains will accomplish in less than half an hour. The whole of the gradients are favorable. It may not be generally known that this line is laid down to a 5 feet gauge, which without greatly increasing the weight of the engines, gives them great mechanical advantages which they have not failed to turn to account.

The engineer to the line is Mr. Braithwaite, to whom much praise is due for the generally efficient manner in which the works and engineering difficulties (not a few) have been executed.

The Dundee and Abroath Railway.—This railway is about fourteen miles in length, with a capital of 100,000*l.* The greater part of the line is carried along the sea shore, through property presented by Lord Panmure to the company. This railway is remarkable for the limited works required

in its construction, and they of scarcely any magnitude except at the end next Dundee, where there is a cutting about a half a mile in length through different strata, composed of gravel, sand, and rock.

London and Croydon Railway—On Saturday, the 1st ultimo, this line was opened by the directors, together with deputations from the London and Brighton and the Greenwich Railway Companies. At a little after one o'clock the trains, two in number, started. The journey down was accomplished in twenty minutes. The station at New Cross is fitted up with every convenience for passengers, &c.; at the back there is a most spacious engine house, of an octagonal shape, and is calculated to hold, exclusive of tenders, sixteen engines.

Brandling Junction Railway.—An experimental trip was performed on the Brandling Junction Railway, on Thursday, May 30, with three beautiful locomotive engines and wagons attached, which ran with a number of passengers from the Monk Wearmouth station to Boldon, where they took in water and then returned. The experiment was in all respects most satisfactory; the railway stood the test to admiration, and the engines performed their work as steadily and smoothly as if they had been used to it. The grand opening of this promising and useful undertaking will take place on the 18th, being the anniversary of the glorious battle of Waterloo. —*Newcastle Journal.*

Birmingham and Derby Junction Railway.—On Wednesday, the 29th May, the directors of the above railway inspected the line between Derby and the junction with the London and Birmingham Railway at Hampton-in-Arden, a distance of about thirty-eight miles. They proceeded from the bridge over the river Dove, a distance of seventeen miles, towards Tamworth, with a train of passenger carriages, drawn by an engine built by Messrs. Charles Tayleure and Co., of Warrington. The line is generally, and on many portions, remarkably straight. The gradients are so extremely favorable that it may almost be said to be a level, and the motion, we are assured by a gentleman who accompanied the directors, was easy and smooth to a degree which they had seldom experienced on any other railway. By the simplicity of construction and stability of the bridge over the Tame and Trent, at their junction near Alrewas, over which the train passed at speed, the directors were strongly impressed. It is near this point that the intended junction with the branch of the Manchester and Birmingham Extension Line is to be effected, by which the traffic from Lancashire to Derby, Nottingham, and the eastern parts of the kingdom, will eventually be brought along the line of this railway. Though some portions of the line were not in so complete a state as to render the further passage of the train advisable, the greater portion of the permanent way was laid, and in a few weeks the engines will be able to pass along the whole distance.—*Midland Counties Herald.*

Grand Junction Railway.—The rates for the carriage of merchandise on this railway were reduced on the 1st inst. The principal reductions are on goods which were formerly charged 1*s.* 6*d.* and 1*s.* 3*d.* per cwt.; the former charge having been reduced to 1*s.* 3*d.* and the latter to 1*s.* 1½*d.* per cwt. The company are now carrying throughout between Liverpool, Manchester and London.

Manchester and Leeds Railway.—An experimental trip on this line of railway was made on Friday, 31st May, by the directors and a party of their friends, consisting altogether of about sixty gentlemen, who proceeded in a train from the station in Manchester to the entrance of the summit tunnel, about three quarters of a mile beyond Littleborough, a distance of

sixteen miles from Manchester. The directors promised, in one of their earlier reports, that this portion of the line would be completed in May, 1839; and, notwithstanding many unexpected difficulties in the progress of the works, they were enabled in some measure to redeem their pledge by the above trip, made on the last day of the month, although the extent of the line travelled over will not be ready for the conveyance of passengers before the beginning of July. The rails on the line are about 60lbs. to the yard. They are laid to such a width, that, in the event of the extension lines uniting, the Leeds and Liverpool and Manchester Railways, at the Hunt's Bank Station, the same engines, carriages, or wagons may proceed forward; there will be a space of six feet between the double line of rails. There are to be three classes of carriages, which will be distinguished by numbers instead of names.—*Abridged from the Manchester Guardian.*

The York and North Midland Railway.—On Wednesday, the 29th ultimo, a portion of this important national and commercial undertaking was opened, from the terminus at York to the junction with the Leeds and Selby Railway, near South Milford, which forms an uninterrupted railway communication between York and Leeds, and York and Selby, and the several intermediate places. The whole line is intended to be completed by the time the North Midland, the Leeds and Manchester, and the Great North of England Railways (of which ti will form the connecting link) can be opened.—*York Courant.*

Opening of the Aylesbury Railway.—On Monday, June 10, the town of Aylesbury was a scene of bustle and vivacity scarcely to be credited. Before six o'clock in the morning, musicians accompanied by persons bearing flags on which suitable devices were inscribed, paraded the streets, after which they proceeded in procession with the directors and their friends to the station. A little after seven o'clock a train started for the terminus, at the junction between Aylesbury and the London and Birmingham line.

London and Southampton Railway.—A distance of twenty miles additional of this railway was on Monday, the 12th ultimo, opened to the public, viz., twelve miles from Southampton to Winchester at the one end, and eight miles from the Winchfield and Hartley-row station to Basingstoke at the other.—*Times.*

Versailles Railway.—The first trial of the whole extent of railway by St. Cloud to Versailles was made on Thursday week. A locomotive engine ran the whole distance from the station in Paris to the Rue St. Symphorien, at Versailles. At all the points near Ville-d'Avray, Sevres, Chaville, Viroflay, and Montreuil, the inhabitants came out in crowds to witness the spectacle. This railway branches from the St. Germain railway, and was undertaken in 1838, by the Paris Rothschilds. It has been two years and a half in progress, and passes through a difficult country. It was opened on Sunday, the 4th instant, and carried 12 or 15 thousand persons, giving a return of 2000*l.*

Railway from Venice to Milan.—One of the most stupendous works of modern times is a projected railroad from Venice to Milan, connecting the seven richest and most populous cities of Italy with each other, Venice, Padua, Vicenza, Verona, Mantua, Brescia, and Milan; the most gigantic portion will be the bridge over the Lagoons, connecting Venice with the main land. The length of the railroad will be 166 Italian (about the same in English,) miles, passing through a population of three and a half millions, the seven cities having alone a population of half a million, viz.,

Venice, 120,000, Padua, 44,000, Vicanza, 50,000, Verona, 46,000, Mantua, 34,000, Briscia, 42,000, and Milan, 180,000 inhabitants, to which may be added 20,000 foreigners in Venice and Milan.—*Foreign Quarterly Review.*

Russia.—At a general meeting of the shareholders in Zarskojeselo railroad, held at St. Petersburgh at the end of last month, it appeared by the report of the directors, that the cost of the formation of the road and its *materiel* had amounted to 5,281,667 roubles. The original calculations were founded upon the anticipation of 300,000 passengers within the year, but, during the preceding twelve months, the number of travellers between the capital and Zarskojeselo had amounted to 500,000, and the number which passed along the whole line to and from Paulowsk was 707,091. The receipts amounted to 920,237 roubles. At the end of the first nine months the receipts exceeded the expenditure by 316,976 roubles. Of this balance 90,000 roubles were applied in paying the interest and reimbursing the loan from the crown; and 140,000 roubles to the payment of interest on shares; 15,848 roubles were divided, according to the statutes, among the directors; 1,555 roubles were paid to the chief engineer; and 69,572 roubles were carried to the reserved fund.

Motto for a Locomotive Engine.—Mr. Editor: Allow me to subscribe *a motto for a Locomotive,* the effusion of an ingenious friend, if you have a corner of your Journal to fill up, perhaps for the novelty and "naivete" of the idea you will inserst it in your next:—

"Upon the four elements I feed,
Which life and power supply,
To run my race of boundless speed,
By loss of one I die."

J. H.

RAILWAY, CANAL, AND ROAD TRAVELLING IN FRANCE.

The current estimates of the French board of works, which amounted to 40,000,000f., (1,600,000*l.*) in 1831, were raised to 45,000,000f. (1,800,000*l.*) in 1837. This very considerable sum is devoted to the maintenance of the roads, bridges and canals. An engineering overseer, who is attached to the administration of each department, directs and manages the works to which the money is applied. Besides these current estimates, a law passed in 1833, gave rise to a vote of extraordinary supplies for public works, which provides for the more important repairs, the completion of undertakings still unfinished, and the construction of new lines of communication. This additional vote, which has been increased by similar laws, passed in the years 1835, 1836, 1837, and 1838, has now reached as large a sum as 350,000,000f., (14,000,000*l.* sterling.) Out of this fund the Chambers have granted 27,000,000f. for the improvement of harbors; 64,000,000f. for the amelioration of the river navigation; 63,000,000f. for the completion of canals began in 1832; to which has been added a vote of 85,000,000f. for a lateral canal to Garonne, between Toulouse and Bordeaux, and a junction canal between the Maine and the Rhine; lastly, the high roads have obtained a grant of 107,000,000f. The *conseils-generaux* in the various departments have voted for the extension of the departmental roads not less than 60,000,000f. When the works now undertaken, and in progress, are finished, there will be in France nearly 8,000 leagues of high roads of the first class (*routes royales,*) 8,500 leagues of high roads of the second class, (*routes departmentales,*) and 850 leagues of canals. An unbroken line of internal navigation will be opened from Havre to Marseiles, and from Stratsburgh to Havre. The principal deficiency in the means of communication in France is celerity. The steamboats have great-

difficulty in ascending against the stream of the larger rivers. The only canal on which the system of fly-boats has been borrowed from the Scotch and English canals, or at least, borrowed with success, is the Canal du Midi, from Toulouse to Cette. The mails, indeed, are transported at an average speed of three leagues an hour. The use of the telegraph is confined to the business of the Government. The railroads which have been executed, up to the present time, are inconsiderable, and the railroads at this moment in exention are for very short distances, their whole united length not exceeding forty-four leagues.—*Civil Engineer and Architect's Journal.*

The Cyclops Steam Frigate.—This magnificent vessel, the largest steam man-of-war in the world, was lately launched from Pembroke Dockyard. Her dimensions are as follows:—Length, 225 feet, beam between paddles 38 feet, depth of hold 21 feet. Her tonage is about 1,300, being 200 tons larger than the Gorgon, launched from the same slip about eighteen months since. Her equipment, as a man-of-war, will be the same in all respects as a frigate, having a complete gun or main deck as well as an upper or quarter deck. On the main deck she will carry eighteen long 36-pounders, and on the upper deck four 48-pounders and two 96-pounders on swivels, carrying a ball of ten inches diameter, and sweeping round the horizon 240 degrees. The Cyclops, like the vessel already referred to, will be commanded by a post captain, these two being the only steamers taking a frigate's rank. Her crew will consist of 210 men, 20 engineers and stokers, and a lieutenant's party of marines, who will have charge of the guns, all of which move upon slides and fixed pivots, thereby taking a much wider range than the ordinary carriage can give. She will be schooner rigged, but her foremast will be of the same scantling and height as that of a 36-gun frigate. Her draught of water, with all on board, including six months' provisions, completely armed, and with twenty days fuel, will be fifteen feet. This quantity of fuel (400 tons) will be carried in the engine room, but there is space in the fore and aft holds for ten days' more coal, making in all sufficient fuel for a thirty days' run. She has an orlop deck below the gun deck, of dimensions so magnificent that there is room to stow with comfort eight hundred troops and their officers, so that, taking her all in all, the Cyclops may be considered the most powerful vessel in her Majesty's service.

New Light for Lighthouses.—A letter of the 10th March from Trieste, states that a new system of producing light for lighthouses has been invented by a serjeant-major in the Austrian artillery, named Selckonsky.—The apparatus consists of a parabolic mirror, 62 inches by 30, with a twelve inch focus, and the light is produced by a new kind of wax candle, invented by M. Selckonsky. It has been tried under the inspection of the Austrian Lloyd's Company in the port of Trieste, by being erected on the mast of a vessel. The light is said to have illuminated the whole of the port and the surrounding parts of the town equal to the moon at full, and at the distance of six hundred yards the finest writing could be read. A second trial has been made in bad weather, and the result was proportionably favorable.—*Civil Engineer and Architect's Journal.*

FAILURE OF THE HYTHE BRIDGE AT COLCHESTER—MR. BRAITHWAITE'S REPORT THEREON TO THE CORPORATION.

This bridge was erected from the plans of a local architect, over the river

Colne, at a place called the Hythe, adjoining the town of Colchester, and up to which point the river is navigable for sailing vessels. The structure was completed, and the road formed and opened for traffic by the latter end of March in the present year; although up to that time the centres had not been eased.

On the 1st of April, on their attempting to remove the centres, the arch followed it; and in their cutting away a bracing piece, the whole structure suddenly fell in—the centres being then unable to sustain the weight thrown upon them. The dimensions of the bridge were as follows: Span of the arch (which was segmental) 58 feet—the rise or versed sine being ten feet; thickness of arch throughout 1 foot six inches; and from face to face of ditto 23 feet. The longitudinal depth or thickness of the abutments, 10 feet; vertical thickness of the abutments, 5 feet—resting on planking laid transversly in sills, which were bedded in a foot and a half of concrete below which, was a loosish strata of gravel. The arch was turned in four half brick rings in cement, with about ten pieces of hoop iron, bedded longitudinally between each ring, and four iron tye-rods with washers placed transversely through the arch; the spandrells were filled up with loose earth, and two small counterfeits, which were carried up in spandrell walls (with the addition of the face walst) had to resist the whole thrust of the arch. Mr. Braithwaite, the engineer in chief of the Eastern Counties railway, was applied to by the corporation to report on the cause of the failure; and after minutely examining the plans and remains of the structure, he gave it as his decided opinion, that the former were so radically bad that it was impossible for the structure to have stood; and on the other hand, that the workmanship was so defective, that with the best and most carefully prepared plans, it must have fallen. Mr. Braithwaite's estimate for a new bridge is 2,200*l.*—the cost of that just destroyed, was about 1,300*l.*

The reverse quoins of the abutments have subsided about an inch and a half; the cement in the arch, it is apparent, was quite killed by the too great admixture of sand; at the keying-in of the arch, such a monstrous want of care was exhibited, as to be worthy of notice—it appears they did not guage their courses, or if so, did not work to it; as, when they arrived at the course of key bricks, there was a space of about 4½ or 5 inches left; now instead of taking out about half a dozen or more courses of bricks—picking out the largest, laying them dry, and then grouting them in—they keyed-in with three-quarter ragged batts, laid longitudinally!—*Civil Engineer and Architect's Journal.*

THEORY OF THE STEAM-ENGINE.

CHAPTER I.—PROOFS OF THE INACCURACY OF THE ORDINARY MODE OF CALCULATION.

(Continued from page 255.)

Section V.—New proofs of the accuracy of the theory proposed, and of the inaccuracy of the ordinary theory.

As we shall draw from the examination of locomotive engines, the greater part of the considerations we are now about to offer on the two theories, we will first observe, with respect to those engines, that we look upon them as being incontestably more proper than all others to make known the true theory of the motion and action of steam. The reasons of this preference are, 1st, that those engines are of a remarkable simplicity; 2d, that the determination of the resistance which they have to move is easy, and susceptible of great exactitude, since it consists merely in weighing the train they have to draw; whereas to estimate the resistance opposed to stationary engines

often requires calculations both various and uncertain; 3d, that the friction of locomotive engines is known from our own experiments, and with a degree of precision that seems to be trustworthy, since that friction has been determined by several methods which have served to verify each other; 4th, that it is easy to observe a locomotive engine under a hundred circumstances different from each other, by varying at pleasure the load and the velocity, which may be done in very wide limits; whereas in stationary engines, it happens most frequently that the resistance to be moved is incapable of variation, whence results that the steam is never seen to act but in one manner, and thus the study of those engines reduces itself nearly to that of one particular case.

To return to the theory we have exposed, it visibly rests chiefly on this, that though the steam be formed in the boiler at a certain pressure P, yet in passing into the cylinder it assumes a pressure R, strictly determined by the resistance against the piston, whatever else may be the pressure in the boiler; so that, according to the intensity of that resistance, the pressure in the cylinder, far from being always equal to that of the boiler, or from differing always from it in any constant ratio, as is believed, may at times be fully equal to it, and at other times considerably different. Thus, when in the ordinary theory, the calculation is performed under the supposition that the steam acts in the cylinder at the pressure of the boiler, an error often very considerable, and independent of all the real losses to which the engine is liable, is introduced into the calculation; since a force is considered as applied, which is two or three times greater than the real one. No wonder then it became necessary to use a coefficient $\frac{1}{3}$ or $\frac{1}{4}$, which makes the supposed losses of the engine appear enormous, whereas the real error is in the very basis of the calculation itself.

We have already proved this mode of action of the steam in the cylinder, from the consideration of uniform motion; but in examining what takes place in the engine, we shall presently find many other proofs.

1st. The steam being generated at a certain degree of pressure in the boiler, passes into the steam-pipe, and from thence into the cylinder; there it dilates at first, because the area of the cylinder is ten or twenty times that of the pipe, and it would quickly rise to the same degree of pressure as in the boiler, were the piston immoveable. But as the piston, on the contrary, opposes only a certain resistance determined by the load imposed on the engine, 40 lbs. for instance, per square inch, it will give way as soon as the elastic force of the steam in the cylinder shall have attained that point. A piston sustaining a resistance of 40 lbs. per square inch is nothing more than a valve loaded with 40 lbs. per square inch. Were the communication perfectly free between the boiler and the cylinder, without tube or contraction, so that the two vessels should form but one, the piston would become a real valve to the boiler; and that valve yielding before the safety valve, which is loaded perhaps at 50 lbs. per square inch, the steam could never rise in the boiler above the pressure of 40 lbs. per square inch. Since the communication between those two vessels is not wholly free, the piston is not a valve to the boiler, but it still continues to be one to the cylinder. Wherefore the pressure in the cylinder can never exceed the resistance of the piston.

2dly. Another consideration will readily prove to us again that the pressure of the steam in the cylinder must necessarily be regulated, not by the pressure in the boiler, but by that of the resistance. In fact, were it actually true that the steam be expended in the cylinder, either at the pressure of the boiler, or at any other pressure that were in any fixed ratio whatever

to that of the boiler, then, since the quantity of steam raised per minute in the boiler would be expended by the cylinder at one and the same pressure in all cases, and would consequently fill the cylinder a fixed number of times in a minute, it would follow that the engine, so long as it should work with the same pressure in the boiler and the same apertures or steam passages, would assume the same velocity with all loads. Now, we see that the very contrary takes place; for the lighter the load, the greater becomes the velocity of the engine.

The effect produced is explained easily, in considering what really passes in the engine. If it be supposed that the evaporation, producing, for instance, 200 cubic feet of steam per minute at the pressure of the boiler, be sufficient to fill the cylinder 200 times, when the piston is loaded with the resistance R; as soon as that resistance R shall be replaced by a resistance $\frac{1}{2}$ R, the same mass of steam assuming in the cylinder a pressure of only half of what it was before, will furnish 400 cylinders-full of steam per minute at the new pressure. It is then clear that the resistance $\frac{1}{2}$ R will be set in motion with a velocity double that of the resistance R; which does in fact accord with observation, if, in estimating that resistance, account be taken of all the partial resistances and frictions really opposed to the motion of the engine.

3dly. Applying the same reasoning inversely, we see that, were the pressure of the cylinder in a fixed ratio with that of the boiler, or were it constant so long as that of the boiler remained the same, then in calculating the effort of which the engine is capable, this would always be found the same, whatever might be the velocity of the piston. Thus, at any velocity whatever the engine would always be capable of drawing the same load. Now this result again is contrary to experience; and the reason of it is that the greater the velocity of the piston, the lower the pressure in the cylinder; whence results, that the load the engine is capable of moving diminishes in the same proportion.

4thly. Another proof no less evident is easily adduced. Were it true that the steam be expended by the cylinder at a pressure equal to that of the boiler, or in any fixed ratio to it, indicated by any coefficient whatever, since any one locomotive engine requires the same number of turns of the wheel, or the same number of strokes of the piston to traverse the same distance, it would follow that so long as these engines work at the same pressure, they ought in all cases to consume the same quantity of water for the same distance. Now, the quantity of water evaporated, far from being constant, decreases, on the contrary, with the load, as may be seen in the experiments we have published on this subject. The *Atlas* engine, for instance, evaporated 132 cubic feet of water in drawing 195·5 tons, and 95 cubic feet only in drawing 127·6 tons. Since the same number of cylinders-full of steam was expended in each case, the steam of the first must have been of a density different from that of the second; and here again it is manifest that, notwithstanding the equality of the pressure in the boiler, and of the opening of the regulator in the two cases, the density of the expended steam followed the intensity of the resistance, that is to say, the pressure of steam in the cylinder was regulated by the resistance.

5thly. From the same cause, since the consumption of fuel must be in proportion to the evaporation effected, it would follow too, were the ordinary theory exact, that the quantity of fuel consumed by a given engine would always be the same for the same distance, whatever might be the load. Now, we find again, by experiment, that the quantity of fuel, on the contrary, diminshes with the load, conformably to the explanation we have given of the effects of the steam in steam-engines.

6thly. It is clear, moreover, that if the pressure in the cylinder were, as it is thought, constant for a given pressure in the boiler, then after an engine has been found capable of drawing a certain load with a certain pressure, and of communicating to it a uniform motion, it would follow that the same engine could never draw a less load with the same pressure in the boiler, without communicating to it a velocity indefinitely accelerated; since the power having been found equal to the resistance in the first case, would necessarily be superior to the resistance in the second. Now, experience proves that in the second case the motion is quicker, but no less uniform than in the first; and the reason is, that though the steam be generated in the boiler at a pressure more or less elevated, which matters little, yet in passing into the cylinder it always assumes the pressure of the resistance; whence results that the power is no more superior to the resistance in the second case than in the first, and that the motion ought therefore to remain uniform.

7thly and lastly. On looking over our experiments on locomotives, the same engine will be seen sometimes drawing a very light load with a high pressure in the boilder, and sometimes, on the contrary, a very heavy load with a low pressure. It is then impossible to admit, as the ordinary theory would have us, that there is any fixed ratio whatever between the two pressures. This effect, moreover, is most easy to explain; for it depends simply on this, that in both cases the pressure in the boiler was superior to the resistance against the piston, and no more was needful in order that the steam, generated at that pressure, or at any other fulfilling merely that condition, might on passing into the cylinder, assume the pressure of the resistance.

It is moreover to be observed, that these effects cannot take place in a locomotive steam-engine, without equally occurring in a stationary one; for the steam acts in the same manner in the cylinders of both, and it is unimportant whether during the action of that steam, the engine moves or remains at rest, or whether its own weight do or do not form a part of the load imposed on the piston.

All these proofs then establish clearly that the pressure of the steam in the cylinder, is strictly regulated by the resistance on the piston and by nothing else; and that all methods, like that of the coefficients, founded on the principle of its being in any fixed ratio whatever with the pressure in the boiler, are necessarily inaccurate.

It is, however, essential to observe, that we wish to establish by these reasonings, that, since the pressure in the cylinder is fixed *a priori*, it cannot depend on the pressure of the boiler; but we believe, on the contrary, as will be seen, Sect. VII., that the pressure in the cylinder being once regulated by the resistance on the piston, that of the boiler afterwards depends on it, in proportion to the size of the passages, the volume of steam produced, and the weight of the safety-valves. It would only be for want of making this needful distinction, that we could be thought to admit an entire independence between the two pressures.

Section VI.—Comparison of the two theories in their application to particular examples.

The foregoing already establishes sufficiently, in principle, the accuracy of the theory which we propose, and the inaccuracy of that which has hitherto been made use of. It may, however, be thought by some that the inaccuracy alleged against the latter is of trifling importance, and that in practical examples it gives results very near the truth at least, if not quite correct. We are

now, therefore, about to submit that method as well as our own to the scrutiny of practice. When in action together, the difference of the results to which they lead will be apparent, and it will be recognized which of the two is more in harmony with the facts; and finally, a clear idea will be formed of the causes from whence the errors of the ordinary theory derive.

The coefficient of correction for high pressure steam-engines without expansion and without condensation, not being fixed to the same amount by the authors who have treated on these subjects, suppose it be attempted to determine it from the two following facts of which we were eye-witnesses.

1. The locomotive engine *Leeds*, which has two cylinders of 11 inches diameter; stroke of the piston, 16 inches; wheels, 5 feet; weight, 7·07 tons; drew a load of 88·34 tons, ascending a plane inclined $\frac{1}{1300}$, at the velocity of 20·34 miles per hour; the effective pressure in the boiler being 54 lbs. per square inch, or the total pressure 68·71 lbs. per square inch.

2. The same day the same engine drew a load of 38·52 tons, descending a plane inclined $\frac{1}{1094}$, at the velocity of 29·09 miles per hour; the pressure in the boiler being precisely the same as in the preceding experiment, and the regulator opened to the same degree. These experiments are given, pages 233, 234, of our *Treaties on Locomotives* (1st edition).

Reckoning, on the one part, the *theoretical* effort applied on the piston according to the ordinary calculation; and on the other part, the effect really produced, viz., the resistance of the load together with that of the air against the train, we find, refering the area of the pistons and the pressure to the square foot:

1st Case.	Theoretical effort applied to the piston, according to the ordinary calculation, 1·32×(68·71×144)	lbs. 13060
	Real effect	8846
	Coefficient of correction	·68
2d Case.	Theoretical effort, the same as above	13060
	Real effect	6473
	Coefficient of correction*	·50

The mean coefficient between the two is ·59. We thus find three differ-

* The detailed calculation of the effects produced is this:

			lbs.
1st Case.	Resistance of the 88·34 tons, at 7 lbs. per ton (*v.* 2d edition of *Treatise on Locomotives*)		618
	Gravity of 95·41 tons (train and engine) on a plane rising $\frac{1}{1300}$		164
	Resistance of the air against the train, at the velocity of the motion		134
	Resistance overcome at the velocity of the wheel		916

And as that resistance is here measured at the velocity of the wheel, it produced against the piston, a force augmented in the inverse ratio of the velocities of the piston and of the wheel, that is to say a resistance of 916 × 5·9 . . . 5404

	Add for the pressure of the atmosphere against the piston, the engine being a high pressure one, 1·32 × (14·71 × 144)		2796
	And for the pressure caused by the blast-pipe 1·32 × (3·4 × 144)		646
	Total resistance against the piston, exclusive of friction		8846
2d Case.	Resistance of the 38·52 tons	270	
	Gravity on the plane descending $\frac{1}{1094}$ —	93	
		177	
	Resistance of the air	282	
	Resistance against the wheel	459	
	Or against the piston, 459 × 5·9		2708
	Add for the pressure of the atmosphere		2796
	And for the pressure caused by the blast-pipe 1·32 × (5·1 × 144)		969
	Total resistance against the piston, exclusive of friction		6473

ent coefficients. Let the first be chosen, an error will be made in the second case; let the second be preferred, and an error will be made in the first case. Let the third be admitted, and the error will only be divided between the two cases. In any way error is inevitable, and that, of itself, suffices to prove that any method, like the ordinary theory, which consists in employing a constant coefficient, is necessarily erroneous, whatever be the coefficient adopted, and to whatever system of engine the application be made; for it is evident that the same fact would occur in every species of steam-engine. It might only be less striking, if the velocities in the two instances were less different, and that is what has hitherto prevented the error of that method from being perceived; for all the engines of the same system being imitated from each other, and working nearly at the same velocity, from a factitious limit that had been imposed on the velocity of the piston, the same coefficient of correction appeared tolerably to suit them all.

In stationary engines, moreover, it was impossible, for want of precise determinations of the frictions, to separate that part of the result which is really attributable to them, from that part which constitutes a veritable error. But here we easily obtain the conviction that neither of these coefficients of correction represent, as we are told, the frictions, losses, and divers resistances of the engine; for direct experiments on the engine under consideration, which are given in our *Treatise on Locomotives*, enable us to estimate separately all those frictions and resistances. Now from these experiments, the friction of that engine, when isolated is equivalent to a force of 82 lbs. applied to the wheel, and that friction afterwards augments by 1 lb. for every ton of load added to the engine.

Besides, the losses to which the engine is liable either from condensation or from waste of steam (during its passage from the boiler to the cylinder) are nothing, or at least inconsiderable.

It becomes easy, then, with these elements, to estimate the amount of the frictions really experienced by the engine. Now in calculating them separately thus, we find:

1st Case. Friction 1257 lbs., or ·10 of the theoretical result.
2d Case. Friction 873 lbs., or ·07 of the theoretical result.*

Thus it appears that in these two cases the friction omitted in the calculation amounted really to but 10 and 7 hundredths of the theorectic results; and if $\frac{1}{20}$ or ·05 of loss be added for the filling up of the vacant spaces in the cylinder, which we have not been able to estimate in lbs., they will amount to ·15 and ·12; whereas the coefficients of correction raise them to ·32 on the one part, and to ·50 on the other; that is, from two to four times what they really are. Deducting, then, from these coefficients, the true value of the frictions and losses, it will be found that the theoretical error which this method brings into the calculation, under the denomination of friction, is 17 per cent. of the *total force of the engine* in one case, and 38 per cent. in the other.

It will now be observed that, from the preceding determinations, viz., of

* We have in fact:

		lbs.	
1st Case.	Friction of the engine without load	82	
	Additional friction for a resistance equivalent to $\frac{916}{7}$ = 131 tons	131	
		213	
	Which produces against the piston 213 × 5·9		1257
2d Case.	Friction of the engine without load	82	
	Additional friction for a resistance equivalent to $\frac{459}{7}$ = 66 tons	66	
		148	
	Which produces against the piston 148 × 5·9		873

the resistances first and then of the frictions, we have for each of the two cases which occupy our attention, the sum of the total effects really produced by the engine, that is:

		lbs.
1st Case.	Resistances	8846
	Frictions	1257
		10103
2d Case.	Resistances	6473
	Frictions	873
		7346

We are now, therefore, enabled to compare these effects produced, with the results, either of the ordinary calculation, or of that which we propose to substitute for it.

1st. In applying, first, the ordinary calculation with the mean coefficient ·59 determined above, and comparing its result with the real effect, we find:

		lbs.
1st Case.	Effort applied on the piston, from the ordinary calculation, $1{\cdot}32 \times (68{\cdot}71 \times 144) \times {\cdot}59$	7705
	Effect produced, including all frictions and resistances	10103
	Error, over and above the frictions and resistances	2398
2d Case.	Effort applied on the piston, from the ordinary theory, the same as above	7705
	Effect produced, including, &c.	7346
	Error, besides frictions and resistances	359
	Mean error of the two cases	1378

It is plain, then, that there would be risk of a very great error in attempting to calculate the effects of this engine with the coefficient ·59; but it is plain, moreover, that in applying any other coefficient *whatever*, the error would only be transferred from the one case to the other, without ever disappearing; and thus, in fact, the coefficient ·59 has almost rendered null the error of the second case above, by transferring it to the first.

To apply now our formula relative to the same problem, viz.,

$$aR = \frac{mSP}{v},$$

nothing more is requisite than to replace the letters m, S, P, and v by their respective values, taking care only to refer all the measures to the same unit.

Thus, P is the total pressure of the steam in the boiler, viz., 68·71 lbs. per square inch, or $68{\cdot}71 \times 144$ lbs. per square foot.

m is the ratio of the volume of the steam, at the total pressure of 68·71 lbs. per square inch, to the volume of the same weight of water; and, according to tables which will be given in the following chapter, $m=411$.

S is the volume of water evaporated per minute, and converted to use in the cylinders. Now, during the journey, of which the first of these experiments was a part, the engine evaporated 60·52 cubic feet of water per hour, (*Treatise on Locomotives*, 1st edition, page 175); which, after a deduction of $\frac{1}{5}$ for the loss of steam by the safety valve, measured, as explained in section VII., and of $\frac{1}{20}$ on the rest for the filling up of the vacant spaces in the cylinder, leaves an *effective* evaporation of ·77 cubic feet of water per minute. We here then have $S={\cdot}77$.

Finally, v is the velocity of the piston; and as the engine moved at a ve-

locity of 20·34 miles per hour in the first case, and of 29·09 miles per hour in the second, which correspond respectively to 298 and 434 feet per minute for the piston, we shall have successively $v=298$ and $v=434$.

Hence the formula gives:

		lbs.
1st Case.	Effort exerted by the engine at the given velocity, from our calculation, $\frac{411 \times \cdot 77 \times (68 \cdot 71 \times 144)}{298}$ . .	10507
	Effect produced, including the frictions and resistances, as above	10103
	Difference	404
2d Case.	Effort exerted by the engine at the given velocity, $\frac{411 \times \cdot 77 \times (68 \cdot 71 \times 144)}{434}$	7215
	Effect produced, including, &c.	7346
	Difference	131
	Mean difference of the two cases	267

We attain then the effect really produced, within a difference of only 267 lbs., a difference which is less than can generally be expected in experiments of this kind, wherein all depends on the management of the fire; whereas the preceding theory gives a *mean* and inevitable error of 1378 lbs., which is $\frac{1}{7}$ of the real effect of the first case, and $\frac{1}{5}$ of the real effect of the second.

2d. To continue the same comparison of the two theories, suppose it were required to calculate what quantity of water the boiler should evaporate per minute to produce either the first or the second effect. The mode of calculation followed by the ordinary theory consists, as we have said, in supposing, first, that the volume described by the piston has been filled with steam at the same pressure as in the boiler, and then in applying to it a coefficient of reduction for the losses.

Now, in the first case, the volume described by the piston at the given velocity, is $av = 1 \cdot 32 \times 298 = 393$ cubic feet. If this volume had been filled with steam at the pressure of the boiler, it would have required an evaporation of water of

$$\frac{393}{411} = \cdot 96 \text{ cubic foot of water.}$$

But the real evaporation was no more than ·77. Therefore the theoretic evaporation of the first case requires a coefficient of

$$\frac{\cdot 77}{\cdot 96} = \cdot 81$$

In the second case, the evaporation similarly computed, supposing the steam to have acted in the cylinder at the pressure of the boiler, is

$$\frac{1 \cdot 32 \times 434}{411} = 1 \cdot 39 \text{ cubic foot of water.}$$

So, for this case the necessary coefficient is ·55. In this problem, therefore, as in the preceding, no constant coefficient *whatever* can be satisfactory.

If, however, the calculation be performed with the mean coefficient ·68, there results:

1st Case. Evaporation per minute calculated by the ordinary theory,

with the coefficient ·68, $\frac{1{\cdot}32 \times 298}{411} \times {\cdot}68$ . . . . ·65

Real evaporation . . . . ·77

Error . . . . ·12

2d Case. Evaporation per minute, calculated by the ordinary theory,

with the coefficient ·68 $\frac{1{\cdot}32 \times 434}{411} \times {\cdot}68$ . . . . . ·95

Real evaporation . . . . ·77

Error . . . . ·18

The mean error committed is then ⅕ of the evaporation; and, for the very reason that it is a medium, it may, in extreme cases, become twice as much.

This is the error committed, when a coefficient is sought *expressly* for the evaporation. But when, instead of that, the coefficient ·59, determined in the preceding problem from the comparison of the theoretic and practical effects, is used as a divisor, as by many authors it is, far greater errors are induced; for we find:

1st Case. Evaporation per minute, calculated by the ordinary theory, with the coefficient ·59 as a divisor, $\frac{298 \times 1{\cdot}32}{411 \times {\cdot}59}$ . . 1·62

Real evaporation . . . . ·77

Error . . . . ·85

2d Case. Evaporation per minute $\frac{434 \times 1{\cdot}32}{411 \times {\cdot}59}$ . . . . 2·36

Real evaporation . . . . ·77

Error . . . . 1·59

In our method, on the contrary, the evaporation necessary to put in motion the resistance a R at the velocity v, is given by the formula

$$S = \frac{a\mathrm{R} \times v}{m\mathrm{P}}.$$

Which gives:

1st Case. Evaporation given by our calculation, $\frac{10103 \times 298}{411 \times (68{\cdot}71 \times 144)}$ ·74

Real evaporation . . . . ·77

Difference . . . . ·03

2d Case. Evaporation given by our calculation, $\frac{7346 \times 434}{411 \times (68{\cdot}71 \times 144)}$ ·78

Real evaporation . . . . ·77

Difference . . . . ·01

3dly and finally, for the case wherein the velocity of the piston is sought, supposing the resistance given, no method like the ordinary one could do otherwise than lead to error, but on this head comparison is unnecessary, since the problem has never yet been solved.

We shall merely, therefore, show the verification of our theory. The formula relative to this problem is:

$$v = \frac{m\mathrm{SP}}{a\mathrm{R}}.$$

And we find:

1st Case. Velocity of the piston, in feet per minute, calculated by our theory, $\frac{411 \times \cdot 77 \times (68\cdot 71 \times 144)}{10103}$ 310

Real velocity 298

Difference 12

2d. Case. Velocity by our calculation, $\frac{411 \times \cdot 77 \times (68\cdot 71 \times 144)}{7346}$. 426

Real velocity 434

Difference 8

It consequently appears that in each of the three problems in question, the theory we propose leads to the true result; whereas the ordinary theory, besides that it leaves the third problem without solution, may, in the two others, lead to very serious errors.

Before abandoning this comparison we will recall attention to an effect, in the calculation of the ordinary theory, of which we have already spoken, but which is here found demonstrated by the facts. It is, that that calculation gives the same force applied by the engine in both the cases considered, notwithstanding their difference of velocity; and such will always be the result, since the calculation consists merely in multiplying the area of the piston by the pressure in the boiler, and reducing the product in a constant proportion. Thus the ordinary theory maintains in principle, that the engine may always draw the same load at all imaginable velocities. Again we see that, in the same computation, viz., that of the load or of the force applied, the evaporation of the engine is not mentioned; which implies that the engine would always draw the same load at all velocities, and whatever might be the evaporation of the boiler; which is impossible.

Lastly, we shall remark that, in the calculation made by the ordinary theory, in order to find the evaporation of the engine, no mention whatever is made of the resistance the engine is supposed to draw; so that the evaporation necessary to draw a given resistance, is independent of that resistance; another result equally impossible.

To these omissions, then, which we regard as errors of principle, and to other causes already noted, are to be attributed the deviations observable in the results of the ordinary theory in the examples proposed.

Section VII.—Of the area of the steam-passages.

There yet remains one point which needs examination, and that is the area of the steam-passages, or the size of the opening of the regulator.

The ordinary theory recognizes in this opening a very important effect on the engine, since it affirms that by increasing or diminishing it, any desired pressure may be produced in the cylinder. Yet no means are afforded us of taking account of this opening in the calculation; unless obliged, as we are already, to have a coefficient for the useful effects and for every species of engine, and another for the evaporation, modified also for every system of engines, and again a different coefficient for all velocities, we be required to have a new one also for every opening of the regulator. But these coefficients are not given, and notwithstanding that the action of the engine is considered to change with the opening of the regulator, yet the calculation is always the same, and made with the same coefficient, whatever that opening may be.

Now, when a stationary engine is at work, its regulator is in constant motion by the effect of the *governor*, and, as it were, unperceived by the engineer. The calculation then of the ordinary theory will be continually at fault; it will be inexact in all cases and at all moments wherein the regulator shall happen to have an opening different from that for which the coefficient employed shall have been determined.

In the theory which we propose, on the contrary, account is taken of the opening of the regulator, or at least of the effects it produces, though its direct measure does not appear ostensibly in the equations. To set this fact in a perfectly clear light, we will first of all establish what are the real effects of the regulator.

We will first prove that the degree of opening of the regulator can have no influence on the pressure in the cylinder, but that its reaction, on the contrary, is upon the pressure *in the boiler;* we will then show that, whatever be the contraction of the regulator, the formulæ will keep account of it, and will continue to give the true effects produced; and finally, we will examine, under each circumstance, what changes do take place in those effects, by reason of the contracting of the orifice of the regulator.

1. It is supposed, in the ordinary theory, that the pressure of steam in the boiler being given and fixed, the contracting more or less of the aperture of the regulator may be made to produce at pleasure a certain pressure in the cylinder. But we have proved that the pressure in the cylinder is, on the contrary, always strictly determined, *a priori*, by the resistance on the piston; the greater or less opening, then, of the regulator can effect no change in it. Besides, how could the contracting of the passage change the *pressure* of the steam which issues through it? It may, we agree, change the *quantity*, because the smallness of the opening will prevent more than a certain portion from passing in a given time, but it certainly never can change its *pressure*. It will, in fact, always happen, that as soon as the steam, on passing into the cylinder, shall attain there the pressure of the resistance, the piston will recede and not allow the steam to assume a greater pressure. And if it be supposed that by enlarging the passage, the steam be made to flow in 10 times, 20 times, 30 times quicker, the piston will recede 10 times, 20 times, 30 times quicker also, since its motion is the result of the arrival of the steam; but never will the pressure of the steam exceed the resistance of the piston, since the piston being a valve to the cylinder, that would be supposing a boiler in which the pressure of the steam were greater than that of the valve.

(To be continued.)

Paris.—A preliminary inquiry has been commenced by order of the Municipal Council of Paris on proposals for establishing two railroads from the capital, one to St. Maur, and the other to Sceaux. The first is intended to commence at the Rue Traversiere St. Antoine, passing through Bercy, St. Maude, Charenton and Vincennes; and the second at the Place de l'Observatoire, running through Gentilly, Arcueil, Bagnieux and Bourg la Reine.—*Commerce.*

Havre Railroad Company.—At a late meeting it was decided, at the pressing instance af M. Aguaudo, that in case it became impossible to give entire execution to the undertaking, it should be carried into effect as far as Rouen, and that the road should terminate, not at St. Sevres, as originally intended, but on the hights of Beauvoisin, passing by Blainville, and the branch lines on Louviers and Elbeuf being suppressed. This decision was definitely adopted, and no consideration, it is said, will induce the company to modify it.—*Civil Engineer and Architects' Journal.*

For the American Railroad Journal, and Mechanics' Magazine.

METEOROLOGICAL RECORD FOR THE MONTHS OF MAY and JUNE, 1839.

Kept on Red River, below Alexandria, La., (*Lat.* 31.10 *N.*, *Long.*, 91.59 *W.*)

1839	Thermometer.					
May	Morn.	Noon.	Night	Wind.	Weath.	Remarks.
1	65	78	74	SE	cloudy	shower in evening
2	64	74	70	S	..	evening heavy thunder shower rain and hail
3	65	71	68	NE	clear	
4	54	70	70	calm	..	
5	67	77	72	NE	..	
6	69	78	73	..	..	
7	70	80	75	calm	..	
8	68	79	76	SE	..	
9	70	84	78	S	cloudy	morning flying clouds all day
10	72	69	78	..	..	11¼ o'clock A.M. a severe gale from SW, heavy
11	66	79	79	..	..	morning clear day { thunder and light show-
12	71	76	72	NW	clear	{ ers, evening clear and
13	63	72	68	..	..	{ showers in the night.
14	54	80	68	SW	..	
15	69	81	69	SE	..	
16	69	78	66	calm	cloudy	light shower morning heavy distant thunders
17	69	80	75	..	..	evening, wind W [all day without rain, SW.
18	68	78	74	..	..	morning, clear day
19	71	84	75	SE	clear	at night heavy rain and thunder and lightning
20	72	82	76	calm	..	cloudy morning clear day
21	73	86	74	..	..	" " "
22	71	90	74	SW	..	
23	68	90	76	S	..	
24	72	87	82	calm	..	foggy morning
25	72	84	79	..	..	
26	72	87	80	..	..	
27	70	89	80	..	..	
28	68	79	72	NE	..	
29	68	80	76	..	..	
30	69	86	78	SE	..	
31	68	89	80	SW	..	
	67.3	81	71	....	....	mean temp. of the month 73.1.
June						
1	70	88	79	SW	clear	
2	68	77	73	..	..	
3	74	76	70	W	..	showers in the morning and heavy thunder
4	66	78	74	NW	..	" " [shower in the night
5	67	78	75	calm	..	evening cloudy
6	67	78	75	NE	cloudy	rain light showers in the morning clear day
7	70	89	82	SE	clear	
8	75	90	82	..	..	
9	77	89	86	..	..	cloudy morning
10	73	90	84	..	..	foggy morning
11	75	91	86	..	..	" "
12	75	90	80	NE	cloudy	morning
13	75	88	86	..	cloudy	evening
14	78	83	84	NW	..	cloudy all day
15	76	82	75	SW	cloudy	evening, clear morning
16	74	88	82	..	clear	
17	88	88	83	W	..	
18	75	88	74	..	..	clear all day heavy showers at night
19	73	80	73	S	cloudy	showers
20	74	86	79	..	clear	
21	80	90	86	..	..	
22	81	94	90	calm	..	
23	80	94	90	..	..	
24	81	95	92	..	..	the hottest day this year so far
25	76	91	83	SW	..	heavy thunder shower at night
26	70	88	86	..	..	
27	74	89	83	..	..	
28	80	95	90	S	..	showers at night, heavy thunder
29	77	90	80	..	..	
30	79	85	80	..	..	evening light shower and thunder
	74	87	81	....	....	mean temp. of the month 81.7 say 81.

St. Germain Railway.—This railway has declared a dividend for the year, of seven and a half per cent.—*Galignani's Messenger.*